LVM-3 / CARE Mission

18 December, 2014

THE MISSION

The first experimental flight GSLV Mk-III X / CARE of India's next generation launch vehicle GSLV Mk-III was successfully conducted on December 18, 2014. The mission began with the launch of GSLV Mk-III at 9:30 AM (IST) from the Satish Dhawan Space Centre (SDSC) SHAR, Sriharikota. Also known as LVM3-X / CARE, this suborbital experimental mission was intended to test the vehicle performance during the critical atmospheric phase of its flight and thus carried a passive (non-functional) cryogenic upper stage.

Two massive S-200 solid strap-on boosters, each carrying 207 tons of solid propellants, ignited at vehicle lift-off and after functioning normally, separated 153.5 seconds later. L110 liquid stage ignited 120 seconds after lift-off, while S200s were still functioning, and carried forward for the next 204.6 seconds.

About five and a half minutes later, Crew Module Atmospheric Re-entry Experiment (CARE) payload weighing 3775 kg was carried to the intended height of 126 km. Following this, CARE separated from the passive C25 cryogenic upper stage of GSLV Mk-III and re-entered the atmosphere and safely splashed down near Andaman and Nicobar Islands in the Bay of Bengal (about 1600 km from Sriharikota) with the help of its parachutes about 20 minutes 43 seconds after lift-off.

Mission Objectives

- Flight validation of the complex atmospheric flight regime of LVM-3
- Validation of new design features
- Overall integrity of the mission design, simulation and software implementation
- Study the re-entry characteristics of Crew Module CARE

L V M - 3

THE LAUNCH VEHICLE

In the LVM-3 flight, active S200 and L110 propulsive stages and a passive C25 stage with dummy engine are used. The C25 stage uses all flight identical structures and interfaces. The LOX and LH_2 tank are filled with Liquid Nitrogen (LN_2) and Gaseous Nitrogen (GN_2) respectively. The external vehicle configuration is identical to that of LVM3-D1 which is the generic vehicle configuration. The payload fairing and spacecraft separation systems are also functional. The mission was designed to provide a suitable altitude, velocity and flight path angle to CARE at separation.

SPECIFICATIONS

Height	43.43 m
Lift-Off Mass	630.58 t
No. of Stages	3
Payload	CARE (Crew Module Atmospheric Re-entry Experiment)
Orbit Height	126 km
Launch Azimuth	120^0
Launch Pad	Second Launch Pad (SDSC, SHAR)

STAGE CHARACTERISTICS			
Parameters	**Stages**		
	S200	**L110**	**C25-X**
Length (m)	25.75	21.26	13.32
Diameter (m)	3.2	4.0	4.0
Propellants	HTPB	N_2O_4 & UH25	LN_2 (for mass simulation)
Propellant Mass (t)	207	115	15
Stage Mass at Lift-off (t)	238	125.6	18.3

New Systems and Features qualified through LVM3-X flight

Demonstration of Paired S200 boosters	• S200 motors are cast with paired / sim sorted propellants to control different thrust • To demonstrate the controlled burn rate dispersion bounds on this pair motors
Validation of baseheating and Aerothermal design	• Complex flow fields with two S200 + two L110 engines • Reverse flow at about 85 s • Thermal design of base region • L110 Nozzle closure performance
Jettisoning motor assisted S200 separation	• Pitch down mode of S200 separation • 6 Jettisoning motors on each S200 stage, 3 on the nose cone and 3 on the base shroud • Circular FLSC based forward and aft separation links
Active/Passive Collet based L110 separation	• Long pullout C25 engine with separation motor assistance • Initial part guided in collet for about 90 mm

Important New Developments for LVM3

- Full redundancy for Control Actuation Systems
- Tripple Modular Redundancy (TMR) for sequencing
- Independent Telecommand System for each stage
- New Separation System for S200/ L110/Spacecraft/PLF (Payload Fairing)
- Tension Release device for PLF and Spacecraft Separation System
- New Modified Polymer Bondex Explosive (MPBX) based destruct system for all stages

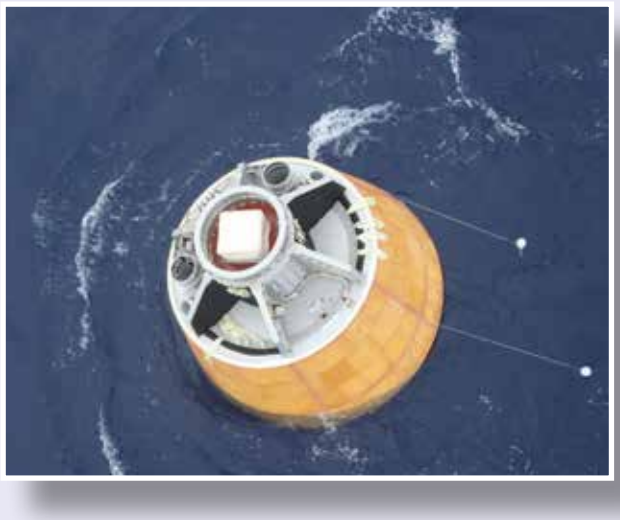
Crew Module Atmospheric Re-entry Experiment (CARE)

Crew Module (CM) is identified as the payload for this mission. The mission would be used as a platform for testing the re-entry technologies envisaged for Crew Module including validating the performance of parachute based deceleration system. CARE is expected to enhance the understanding of blunt body re-entry aerothermodynamics and parachute deployment in cluster configuration.

The Crew Module (CM) was separated from the Launch Vehicle at an altitude of 126 km, re-enters Earth's atmosphere at about 80 km and descends further in ballistic mode. Beyond 80 km, CM follows an uncontrolled re-entry trajectory and impacts at sea about 180 km from Andaman and Nicobar Island from where it was recovered by Indian Coast Guard.

Objectives

1. Demonstration of re-entry flight of Crew Module
2. End-to-end parachute system validation
3. Demonstration of apex cover separation
4. Demonstration of parachute deployment



SPECIFICATIONS

Weight	3735 kg
Configuration	Aluminium Alloy metallic structure with CFRP panels
Thermal Protection System	Side panels and apex cover Medium Density Ablative (MDA) tiles; forward heat shield with Carbon phenolic tiles
RCS (6)	100 N thruster with MMH and MON-3 propellants
Deceleration System	Two independent chain of parachutes consisting of pilot of parachute (2.3 m dia); drop chute (6.2 m dia), and main chute (31 m)
Type	Experimental
NGC	3-axis controlled upto re-entry with mini resins for navigation and 100 N thrusters for Control